PE-152

Electronic Shelf Label

The PE-152 is an e-paper based electronic shelf label with a screen size of 1.5". It has a build-in RFID reader plus several 3-color LEDs.

V0

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The information in this document is subject to change without notice.

Document History

Model Number:	PE-152	Original release date	2-5-2018
Revision:	V0	Date	2-5-2018

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Limited Warranty and Disclaimers

Please read this manual carefully before installing or using the product.

Serial Number

A serial number appears on all Opticon products. This official registration number is directly related to the device purchased. Do not remove the serial number from your Opticon device. Removing the serial number voids the warranty.

Warranty

Unless otherwise agreed in a written contract, all Opticon products are warranted against defects in materials and workmanship for two years after purchase excluding batteries. Opticon will repair or, at its option, replace products that are defective in materials or workmanship with proper use during the warranty period. Opticon is not liable for damages caused by modifications made by a customer. In such cases, standard repair charges will apply. If a product is returned under warranty and no defect is found, standard repair charges will apply. Opticon assumes no liability for any direct, indirect, consequential or incidental damages arising out of use or inability to use both the hardware and software, even if Opticon has been informed about the possibility of such damages.

Packaging

The packing materials are recyclable. We recommend that you save all packing material to use should you need to transport your data collector or send it for service. Damage caused by improper packaging during shipment is not covered by the warranty.

Trademarks

Trademarks used are the property of their respective owners.

Opticon Inc. and Opticon Sensors Europe B.V. are wholly owned subsidiaries of Optoelectronics Co., Ltd., 12-17, Tsukagoshi 4-chome, Warabi-shi, Saitama, Japan 335-0002. TEL +81-(0) 48-446-1183; FAX +81-(0) 48-446-1184

SUPPORT

USA
Phone: 800-636-0090
Email: support@opticonusa.com
Web: www.opticonusa.com

Europe
Email: support@opticon.com
Web: www.opticon.com

Revision History

Product Name : PE-152

Edition	Date	Page	Section	Description of Changes
V0	21-12-2017	-	-	Preliminary Version

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1   Abstract

This manual provides specifications for the PE-152 RFID reader & Electronic Shelf Label (hereafter also referred to as "ESL").

2   Overview

The PE-152 is an e-paper based Electronics Shelf Label with a 2.4GHz radio for data communication that also features an active RFID reader, 3-color LED's and a buzzer, externally powered via a rail system. This product uses Direct Sequence Spread Spectrum RF technology that allows for ultra-low power consumption combined with a reduced sensitivity to background noise. That means less interference by other radios that operate in the 2.4GHz band. The radio protocol that is used is based on the IEEE 802.15.4 standard that specifies the physical layer and media access control for low-rate wireless personal area networks. The RFID reader in this product supports all the major RFID protocols, like Mifare, Mifare classic, DESFire and many others.

A development kit is available that consists out of a base station, several ESL tags, a powered rail complete with PC software that allows people to quickly test the system and makes it easier to integrate this ESL system into an existing back office system.

3   Physical Features

3.1   Dimensions

W 48.4 mm x H 42.2 mm x D 11.3 mm
When mounted on a dedicated power rail (available as separate item), the thickness is 12.1mm.
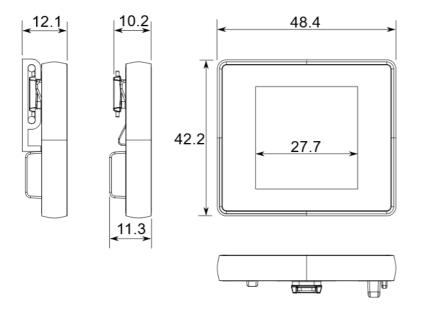

Figure 1: Dimensions

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3.2 Weight

30.0 g   TBD

4 Environmental Specifications

Conditions unless otherwise specified

Power Supply Voltage   5.0 V
Temperature   20°C

4.1 Operating Temperature and Humidity

Temperature: 0 to 40° C
Humidity: 20 to 85% RH (Non-Condensing)

4.2 Storage Temperature and Humidity

Temperature: -20 to 60° C
Humidity: 20 to 85% RH (Non-Condensing)

4.3 Humidity

Operating Humidity   5 to 90% RH (no condensation, no frost)
Storage Humidity   5 to 90% RH (no condensation, no frost)

4.4 Static Electricity

Air discharge:	± 8 kV MAX (No malfunction) ± 15 kV MAX (No destruction)
Contact discharge:	± 4 kV MAX (No malfunction) ± 8 kV MAX (No destruction)

4.5 Electrical Noise

There shall be no abnormalities when sinusoidal electrical noise (50 ~ 100 kHz, less than $0.3V_{pp}$) is added to the power supply line.

4.6 Vibration Strength

There shall be no sign of malfunction of the PE-152 after the following test.
Vibration Test: Increase the frequency of the vibration from 12 ~ 200Hz at accelerated velocity $29.4m/s^2$(3G) for ten minutes. Continue this routine for 2 hours to X-direction, 2 hours to Y-direction and 4 hours to Z-direction.

4.7 Drop Impact Strength

There shall be no sign of malfunction of the PE-152 after the following test.
Drop the PE-152 ten times in total, at top, bottom, front, back, left, right, top-left, top-right, bottom-left and bottom-right faces, from a height of 1.5 meter onto a concrete floor.

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5   Controls

Items	Specifications		Remarks
CPU	Type	8051 core 8-bit MCU	
	Internal flash ROM	256KB	
	Internal RAM	8 KB	
	Clock frequency	32 MHz	
LCD	Active area	W 27.51 x H 27.51 mm	
	Number of dots	W 152 x H 152	Black & White. Red is on request
	Dot pitch	140 Horizontal 140 Vertical	Dots per Inch
Radio	Modulation	DSSS	
	Frequency	2394 ~ 2507 MHz	Globally approved 2.4GHz band.
	Baud rate	250 Kbits / second	
RFID	Frequency	13.56MHz	
	Protocols	ISO/IEC 14443A/MIFARE ISO/IEC 14443B JIS X 6319-4 (comparable with FeliCa) ISO/IEC 18092 ISO/IEC 15693 ICODE EPC UID/ EPC OTP ISO/IEC 18000-3 mode 3/ EPC Class-1 HF	
Buzzer	Resonance frequency	2731 Hz	The ESL server controls the sounds.
LED	Number of LEDs	4	
	Dominant wavelength	Red: 624 nm Green: 525 nm Blue: 470 nm	

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6   Electrical Specifications

6.1   Electrical Characteristics

Parameter	Min.	Typ.	Max.	Unit	Remarks
Operating voltage	4.5	5 or 12	16	V	LED and Buzzer perform less with lower operating voltages.
Standby current[1]		60 30	65 35	mA[2] mA[3]	RFID active, LED's and buzzer off
Operating current		235 125	240 130	mA[2] mA[3]	All LED's (3 colors) and buzzer on
		140 75	150 85	mA[2] mA[3]	All LED's (3 colors) on, buzzer off
		70 35	80 40	mA[2] mA[3]	Picture update, LED's & buzzer off

[1]The ESL is in standby mode almost the entire time, trying to read an RFID tag. However shortly after a tag is read and the data inside the tag is sent to the ESL server, the ESL can get a command to switch on its LED's and buzzer. The duration of this is typically less than 1s.
[2] At 5V supply voltage
[3] At 12V supply voltage

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7 Radio Specifications

Parameter	Min	Typ	Max	Unit	Remarks
Receiver sensitivity		-97	-89	dBm	Over the entire temp. and operating voltage range
Nominal output power	-3	4.5	7	dBm	
Frequency	2405		2480	MHz	Over the entire temp. and operating voltage range
Transfer rate		250Kbit/s			
RSSI range		100		dB	Signal strength indication that can be reported to the base station

7.1 Protocol

Modified 802.15.4 (Physical layer and Media Access Control layer).

7.1.1 The physical layer

The physical layer (PHY) provides the data transmission service, as well as the interface to the physical layer management entity, which offers access to every layer management function and maintains a database of information on related personal area networks. Thus, the PHY manages the physical RF transceiver and performs channel selection and energy and signal management functions. It operates on the above mentioned frequency band. The PHY layer is 100% compliant and is based on direct sequence spread spectrum (DSSS) technique with a transfer rate of 250 kbit/s.

7.1.2 The medium access control layer

The medium access control (MAC) layer enables the transmission of MAC frames through the use of the physical channel. Besides the data service, it offers a management interface and itself manages access to the physical channel. It also controls frame validation, guarantees time slots and handles node associations. Finally, it offers hook points for secure services. The EE-202 does not make use of the optional network beaconing, instead it used a polling mechanism to increase power efficiency. Some changes are made to the standard to allow for more efficient data frames and better power efficiency, especially when nodes are not connected to a base station.

7.2 Security

Standard encryption methods are implemented for the RFID reader as defined in the various RFID standard, like Mifare DESFire. Also the data sent over the 2.4GHz radio can be encrypted. For that, 128-bit AES encryption is used.

8 Labeling

8.1 Product Label

The product label is affixed to the ESL as shown below.

Figure 2: Product Label

Label material:
Material: Base + laminate protection against wear.
Base: PP film, thickness 80µm, backing with glue.
Laminate: PET film, clear, thickness 25µm.
RoHS compliant

Label dimension:
36 x 19 mm (w x h)
Tolerance ± 0.1mm
Corner radius 1mm

Barcode area:
The size of the barcode area (without the human readable part) is 2.6x27.9mm).

The barcode shows the product serial number. This is a 'B2E' followed by 5 hexadecimal digits. This serial number is the same as the MAC address in the ESL-label, with the first 6 digits ('3889DC') replaced by a 'B'.

Figure 3: Product Label dimensions

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8.2 Shipment Box Labels

The shipment box labels are meant to show the regulatory information on the shipment box as well as the quantity in the box. The labels are 150mm*95mm and are made from plain paper with adhesive backing.
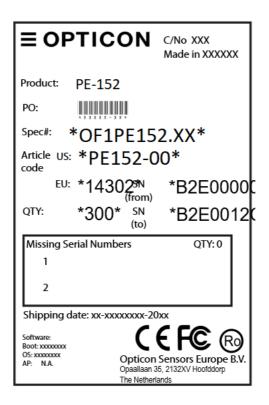

Figure 4: Shipment box label

9 Packaging Specifications

9.1 Individual Packaging Specification

The ESL's do not need to be packed separately. To easily pack them, 30 pcs need to be packed in a plastic molded tray:
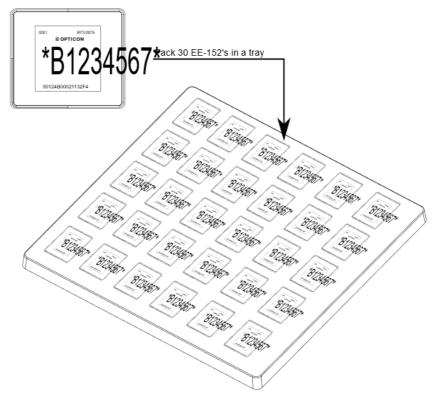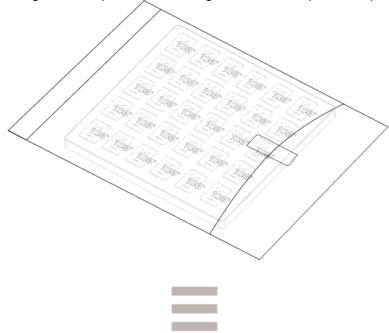

Figure 5: Individual packaging

9.2 Collective Packaging Specification

Use two silica bags and tape them at the bottom of the tray. Then pack the tray with 30 PE-152's in a plastic bag, fold the open end of the bag and fix it with a piece of tape.
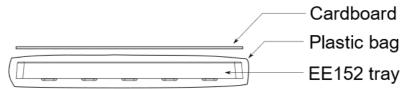
Figure 6: collective packaging

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Put 10 stacks, containing 300 ESL's inside a box and stick the shipment box label on the indicated position. Use cardboard and a plastic bag between each layer of ESL's as shown below.
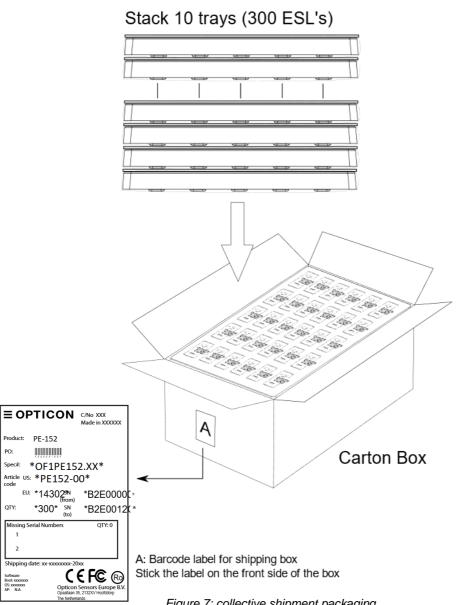

Stack 10 trays (300 ESL's)

A: Barcode label for shipping box
Stick the label on the front side of the box

Figure 7: collective shipment packaging

Note: The "RO" mark labelled on the package tray or package box guarantees that the applicable product has passed our test of RoHS restrictions compliance (the restriction of the use of certain hazardous substances in electrical and electronic equipment, 2002/95 EC). However, this document does not have any legal weight in the European Union.

10 Regulatory Compliance

10.1 Product Safety

EN 60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013
IEC 60950-1:2005 (2nd Edition) + Am 1:2009+Am 2:2013

10.2 EMC

EN55022: 2010

EN55024: 2010

Federal Communications Commission (FCC) Statement

15.21
You are cautioned that changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

15.105(b)
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1) this device may not cause interference and
2) this device must accept any interference, including interference that may cause undesired operation of the device.

RF Radiation Exposure Statement:

1) This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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2) This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

10.3 WEEE

Waste Electrical and Electronics Equipment Directive, 2012/19/EU.

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact your local city office, your household waste disposal service or the supplier where you purchased the product.

10.4 RoHS

RoHS: The restriction of the use of certain hazardous substances in electrical and electronic equipment, 2011/65 EC.

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11 Safety

Handle this product carefully. Do not deliberately subject it to any of the following.

11.1 Shock

Do not throw or drop the ESL.
Do not place heavy objects on the ESL.

11.2 Temperature Conditions

Do not use the ESL at temperatures outside the specified range.
Do not pour boiling water on the ESL.
Do not throw the ESL into the fire.
Do not leave the ESL on the dashboard of a car.

11.3 Foreign Materials

Do not immerse the ESL in liquids.
Do not subject the ESL to chemicals.

11.4 Other

Do not disassemble this product.
The ESL may be damaged by static electricity.

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12 Mechanical Drawing

Figure 8: Mechanical drawing